Announcing the Final Examination of Alireza Safaei for the degree of Doctor of Philosophy in Physics

Date: Thursday, March 28, 2019
Time: 3:00 PM
Room: Physics 160

Dissertation Title:

"Nanoplasmonics in two-dimensional Dirac and three-dimensional metallic nanostructure systems"

Abstract:

Surface plasmons are collective oscillation of electrons which are coupled to the incident electric field. Excitation of surface plasmon is a route to engineer the behavior of light in nanometer length scale and amplifying the light-matter interaction. This interaction is an outcome of near-field enhancement close to the metal surface which leads to plasmon damping through radiative decay to outgoing photons and nonradiative decay inside and on the surface of the material to create an electron-hole pair via interband or intraband Landau damping.

Plasmonics in Dirac systems such as graphene show novel features due to massless electrons and holes around the Dirac cones. Linear band structure of Dirac materials in the low-momentum limit gives rise to the unprecedented optical and electrical properties. Electronical tunability of the plasmon resonance frequency through applying a gate voltage, highly confined electric field, and low plasmon damping are the other special propoerties of the Dirac plasmons.

In this work, I will summarize the theoretical and experimental aspects of the electrostatical tunable systems made from monolayer graphene working in mid-infrared regime. I will demonstrate how a cavity-coupled nanopatterned graphene excites Dirac plasmons and enhances the light-matter interaction. The resonance frequency of the Dirac plasmons is tunable by applying a gate voltage. I will show how different gate-dielectrics, and the external conditions like the polarization and angle of incident light affect on the optical response of the nanostructure systems. I will then show the application of these nanodevices in infrared detection at room temperature by using plasmon-assited hot carriers generation. An assymetric nanopatterned graphene shows a high responsivity at room temperature which is unprecedented. At the end, I will demonstrate the properties of surface plasmons on 3D noble metals and its applications in light-funneling, photodetection, and light-focusing.

Major: Physics

Educational Career:

BS : 2010, Physics, University of Isfahan
MS : 2012, Physics, Sharif University of Technology
MS : 2018, Physics, University of Central Florida

Committee in Charge:
Dr. Debashis Chanda (Chair)
Dr. Michael N. Leuenberger
Dr. Lei Zhai
Dr. Eduardo Mucciolo

Approved for distribution by Dr. Debashis Chanda, Committee Chair, on March 11, 2019.

The public is welcome to attend.